

Lecture Module - Steady State Circuits

ME3023 - Measurements in Mechanical Systems

Mechanical Engineering

Tennessee Technological University

Topic 1 - Components, Units, and Symbols

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- Common Passive Components
- Important Electrical Quantities
- Units and Symbols
- Types of Switches

Common Passive Components

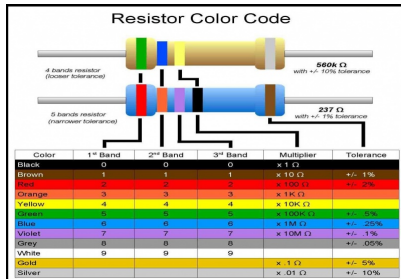
Passive components affect the behavior of a circuit in different ways but they do not generate power and can only absorb energy or transform it into heat. Active components on the other hand...

- Resistor
- Capacitor
- Inductor

Most circuits require an active power source for operation. A voltage source is used in most applications however current sources are also available and are needed for specialized electrical applications.

Common Passive Components

Components are identified by color codes and numbering systems. However it is always a good idea to measure for yourself because a marking can be incorrect or a component may be damaged.



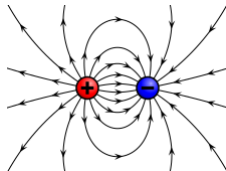
Codes of Ceramic Disc Capacitor

www.circuitspedia.com

| Picofarad pF | Nanofarad nF | Microfarad μF | CODE | Picofarad pF | Nanofarad nF | Microfarad μF | CODE |
|-----------------|-----------------|------------------|------|-----------------|-----------------|------------------|------|
| 10 | 0.01 | 0.00001 | 100 | 4700 | 4.7 | 0.0047 | 472 |
| 15 | 0.015 | 0.000015 | 150 | 5000 | 5.0 | 0.005 | 502 |
| 22 | 0.022 | 0.000022 | 220 | 5600 | 5.6 | 0.0056 | 562 |
| 33 | 0.033 | 0.000033 | 330 | 6800 | 6.8 | 0.0068 | 682 |
| 47 | 0.047 | 0.000047 | 470 | 10000 | 10 | 0.01 | 103 |
| 100 | 0.1 | 0.0001 | 101 | 15000 | 15 | 0.015 | 153 |
| 120 | 0.12 | 0.00012 | 121 | 22000 | 22 | 0.022 | 223 |
| 130 | 0.13 | 0.00013 | 131 | 33000 | 33 | 0.033 | 333 |
| 150 | 0.15 | 0.00015 | 151 | 47000 | 47 | 0.047 | 473 |
| 180 | 0.18 | 0.00018 | 181 | 68000 | 68 | 0.068 | 683 |
| 220 | 0.22 | 0.00022 | 221 | 100000 | 100 | 0.1 | 104 |
| 330 | 0.33 | 0.00033 | 331 | 150000 | 150 | 0.15 | 154 |
| 470 | 0.47 | 0.00047 | 471 | 200000 | 200 | 0.2 | 254 |
| 560 | 0.56 | 0.00056 | 561 | 220000 | 220 | 0.22 | 224 |
| 680 | 0.68 | 0.00068 | 681 | 330000 | 330 | 0.33 | 334 |
| 750 | 0.75 | 0.00075 | 751 | 470000 | 470 | 0.47 | 474 |
| 820 | 0.82 | 0.00082 | 821 | 680000 | 680 | 0.68 | 684 |
| 1000 | 1.0 | 0.001 | 102 | 1000000 | 1000 | 1.0 | 105 |
| 1500 | 1.5 | 0.0015 | 152 | 1500000 | 1500 | 1.5 | 155 |
| 2000 | 2.0 | 0.002 | 202 | 2000000 | 2000 | 2.0 | 205 |
| 2200 | 2.2 | 0.0022 | 222 | 2200000 | 2200 | 2.2 | 225 |
| 3300 | 3.3 | 0.0033 | 332 | 3300000 | 3300 | 3.3 | 335 |

Important Electrical Quantities

- **Charge** - the physical property of matter that causes it to experience a force when placed in an electromagnetic field.



- **Voltage** - the difference in electric potential between two points ... can be caused by electric charge, by electric current through a magnetic field, by time-varying magnetic fields, or some combination of these three.
- **Current** - the rate of flow of electric charge past a point or region. An electric current is said to exist when there is a net flow of electric charge through a region.

Important Electrical Quantities

- **Resistance** - a measure of a components opposition to the flow of electric current. The inverse quantity is electrical conductance, and is the ease with which an electric current passes.
- **Capacitance** - the ratio of the change in electric charge of a system to the corresponding change in its electric potential (voltage).
- **Inductance** - the tendency of an electrical conductor to oppose a change in the electric current flowing through it. The flow of electric current creates a magnetic field around the conductor. The field strength depends on the magnitude of the current, and follows any changes in current.

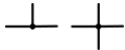
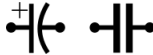
Units and Symbols

| Quantity | Symbol | Unit | Abbr. |
|-------------|--------|---------|----------|
| Charge | Q,q | Coulomb | C |
| Voltage | V,v | Volt | v |
| Current | I,i | Ampere | A |
| Resistance | R | Ohm | Ω |
| Capacitance | C | Farad | F |
| Inductance | L | Henry | H |

Question: When should you use upper case or lower case letters for electrical quantities?

Units and Symbols

When working with a or building a circuit you need a diagram. Draw or find one before you begin. Here are some commonly used symbols.



Types of Switches

A switch is a mechanical-electrical device that that can change from a continuous state to a dis-continuous state and they are used as a mechanical interface to a circuit. There many different types of switches for different purposes and this is not an exhaustive list.

- Toggle Switches
- Momentary Switches
- Reed Switches
- Level or Float Switches
- and many more

Types of Switches

Toggle switches are possibly the most commonly used switches and they come in many different forms.

Poles - The numbers of poles refers to the number of independent conductors or circuits in a switch that are controlled by the same toggle or input.

Throws - The numbers of throws refers to the number of output terminals of a switch per pole.

